

Patent claims

1. A composite structure comprising at least:
 - 5 • a structural layer C1;
 - a weight-reducing layer C2 of rigid or semirigid foam; and
 - optionally a structural layer C3characterized in that the foam is a polyamide-based
10 foam.
2. The composite structure as claimed in claim 1, characterized in that it is a sandwich structure comprising two outer structural layers C1 and C3, and a
15 weight-reducing internal layer C2.
3. The composite structure as claimed in claim 1 or 2, characterized in that at least one structural layer is a plate or a sheet.
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4. The composite structure as claimed in claim 3, characterized in that at least one structural layer is a plate or a sheet of metal or of a metal alloy such as a steel.
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5. The composite structure as claimed in one of the preceding claims, characterized in that the thickness of the structural layer is between 0.2 and 3 mm.
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6. The composite structure as claimed in claim 5, characterized in that its thickness is between 3 and 50 mm.
- 35 7. The composite structure as claimed in one of the preceding claims, characterized in that the density of the foam is less than 300 kg/m³, and preferably between 30 and 200 kg/m³.

8. The composite structure as claimed in one of the preceding claims, characterized in that the Young's modulus (modulus of elasticity in compression) of the foam is greater than or equal to 30 MPa.

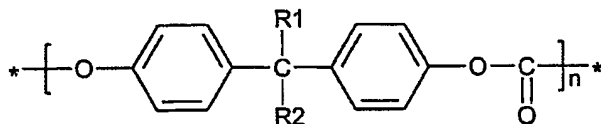
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9. The composite structure as claimed in one of the preceding claims, characterized in that the polyamide foam is obtained by injecting gas into the polyamide and/or by incorporating volatile compounds, blowing agents and/or a compound that can react with the polyamide to form gas, in the polyamide.

10. The composite structure as claimed in claim 9, characterized in that the foam is obtained from a mixture of polyamide and polycarbonate.

11. The composite structure as claimed in claim 10, characterized in that the polycarbonate is a polycarbonate comprising aromatic rings of formula:

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in which R₁ and R₂, which may be identical or different, are hydrogen atoms, halogen atoms or alkyl or haloalkyl radicals containing between 1 and 5 carbon atoms, and each aromatic ring can be substituted by alkyl or haloalkyl radicals containing between 1 and 5 carbon atoms; n is an integer between 40 and 300.

12. The composite structure as claimed in claim 10 or 11, characterized in that the molecular weight of the polycarbonate is between 5000 and 80000.

13. The composite structure as claimed in one of the claims 10 to 12, characterized in that the mixture

contains 0.5 to 20 wt.% of polycarbonate relative to the polyamide, and preferably 5 to 15 wt.%.

14. The composite structure as claimed in one of the claims 10 to 13, characterized in that the foam is obtained by heating the mixture of polyamide and polycarbonate at a temperature greater than or equal to the melting point of the polyamide.

15. The composite structure as claimed in one of the preceding claims, characterized in that at least one structural layer is a plate or a sheet comprising a thermoplastic or thermosetting polymer matrix.

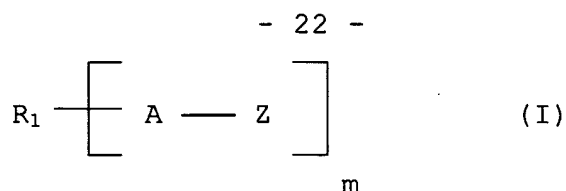
16. The composite structure as claimed in claim 15, characterized in that at least one structural layer is a plate or a sheet comprising a thermoplastic or thermosetting polymer matrix and reinforcing fibers, such as fibers of glass, carbon, aramid, polyimide, quartz, sisal, hemp, flax etc.

17. The composite structure as claimed in claim 15 or 16, characterized in that the matrix comprises a star-structured polyamide comprising:

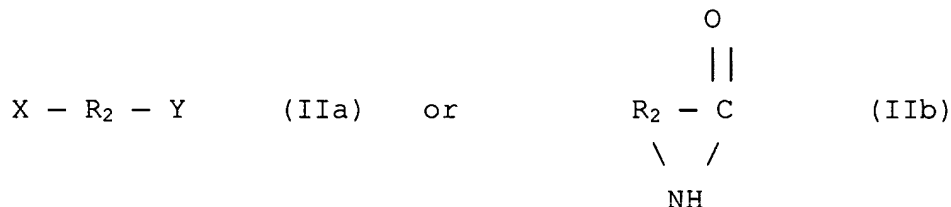
- star-structured macromolecular chains comprising one or more cores and at least three arms or three polyamide segments connected to the core,
- if necessary, linear macromolecular polyamide chains.

18. The composite structure as claimed in claim 17, characterized in that the star-structured polyamide is of the type of polyamides obtained by copolymerization of a mixture of monomers comprising at least:

- a) monomers of the following general formula (I):



b) monomers of the following general formulas (IIa) and (IIb):



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c) optionally monomers of the following general formula (III):



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in which:

- R_1 is a hydrocarbon radical having at least 2 carbon atoms, linear or cyclic, aromatic or aliphatic and which may contain heteroatoms,
 - A is a covalent bond or an aliphatic hydrocarbon radical which may contain heteroatoms and has from 1 to 20 carbon atoms,
 - Z represents a primary amine function or a carboxylic acid function,
 - Y is a primary amine function when X represents a carboxylic acid function
- or
- Y is a carboxylic acid function when X represents a primary amine function,
 - R_2 and R_3 , which may be identical or different, represent substituted or unsubstituted, aliphatic, cycloaliphatic or aromatic hydrocarbon radicals having from 2 to 20 carbon atoms and which may contain heteroatoms,
 - m represents an integer between 3 and 8.

19. A method of production of the composite structure as claimed in one of the claims 1 to 18 comprising a stage of assembly of at least the
5 following elements:

- (C1'): a structural layer or a precursor of said layer;
- (C2'): a weight-reducing layer of polyamide-based
10 foam or a precursor of said foam; and
- optionally (C3'): a structural layer or a precursor of said layer.

20. The method as claimed in claim 19,
15 characterized in that the precursor of the foam is a powder or an article comprising an expandable polyamide composition containing polyamide and an expanding agent.

20 21. The method as claimed in claim 20, characterized in that the expanding agent is a polycarbonate.

22. The method as claimed in one of the claims 19
25 to 21, characterized in that the precursor of at least one structural layer is an article containing reinforcing fibers.

23. The method as claimed in claim 22,
30 characterized in that the precursor of at least one structural layer comprises:

- an article containing reinforcing fibers; and
- a polymer matrix

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24. The method as claimed in claim 22, characterized in that the precursor of at least one structural layer is an article containing reinforcing

threads and/or fibers and threads and/or fibers of polymer matrix.

25. The method as claimed in claim 24,
5 characterized in that the article is in the form of continuous or cut threads, strips, mats, of braided, woven or knitted fabrics, fleece, multiaxial materials, nonwovens and/or of complex forms comprising several of the aforementioned forms..

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26. The method as claimed in one of the claims 19 to 25, characterized in that assembly is carried out by thermoforming or calendering of the various elements (C1'), (C2') and optionally (C3'), the various elements
15 being thermoformed or calendered simultaneously or successively.

27. The method as claimed in claim 26,
20 characterized in that the thermoplastic polymer matrix of the precursor of at least one structural layer is a thermoplastic matrix and in that the temperature during thermoforming or calendering is greater than or equal to the melting point of the thermoplastic matrix.

25 28. Use of the composite structure as claimed in one of the claims 1 to 18 for making automobile or aircraft components or for making sports articles such as skis or for the manufacture of building panels.